**Current status of search for element 119**

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Search for the new element 119 is ongoing at RIKEN by the nSHE collaboration. Current status of the experiment is briefly described. Research Center for Superheavy Elements was recently founded at Kyushu University. Experimental and theoretical research activities at the center are also explained.

**1. Introduction**

Search for new elements is a part of an attempt to find the limits of existence of the elements and atomic nuclei. In addition, new elements may have unique chemical properties which could open up new possibilities of application. Up to present, 118 elements have been found and named. Those heaviest elements were artificially synthesized by using the fusion reaction, and the 7th row of the periodic table has been completed. To extend our knowledge on the physical and chemical properties of heavy elements and nuclei, further search for the element 119, a new element in the 8th period, was started at RIKEN in 2018 by an international nSHE collaboration composed of more than ten institutes. Around the same time, Kyushu University founded a new research center, Research Center for Superheavy Elements, to reinforce the research activities on the science of superheavy elements in Japan.

**2. Current status of search for element 119**  
 For the efficient synthesis of element 119, a hot fusion method was adopted since it is expected to have a higher production cross section than the cold fusion which was used to synthesize the element 113, nihonium [1]. It is well known that the cross section increases as the system becomes more “asymmetric”, i.e. when the atomic number (Z) of the beam nucleus becomes lower and that of the target nucleus higher. On the other hand, the amount of high-Z target material is severely limited since it has to be artificially produced in a nuclear reactor making use of its high-flux neutron environment. For the nSHE experiment, 248Cm material is supplied from Oak Ridge National Laboratory (ORNL). The material is processed and prepared as a rotating target at RIKEN. In addition to the 248Cm target, one needs a 51V beam, a separator, and a detection system. A new separator, GARIS-II was newly constructed [2] aimed at enlarging the angular acceptance for a higher collection efficiency for hot-fusion products and also at decreasing the background-event rate. The GARIS-II was installed at the RIKEN Ring Cyclotron (RRC) facility in 2017. The search for element 119 was initiated in January 2018 with a 51V beam accelerated by the RRC [3]. From 2018 to 2019, the nSHE experiment has been performed intermittently. The detection system, consisting of MCP-ToF detectors and DSSDs, has been continuously upgraded.

In parallel with the nSHE experiment at the RRC facility, the RILAC facility has been upgraded to increase the beam intensity by 5–10 times. A 28 GHz superconducting ECR ion source and a superconducting quarter-wavelength resonator are being installed. To perform the nSHE experiment at the upgraded RILAC facility, a new separator GARIS-III is under construction. The nSHE experiment will soon be started with these new devices at the RILAC facility.

**3. Research Center for Superheavy Elements at Kyushu University**  
 Research Center for Superheavy Elements (RCSHE) was founded in 2018 at Kyushu University. Activities related to the nSHE experiment are ongoing as below. (1) A beamline dedicated for SHE research was constructed at the Center for Accelerator and Beam Applied Science (CABAS) at Kyushu University. (2) Reaction studies such as measurement of quasi-elastic barrier distribution has been carried out using a Tandem accelerator. (3) An analysis group of nSHE data has been launched independently of the RIKEN group to secure complementarity and objectivity of the interpretation of the data. (4) Basic development of the detectors (MCP-ToF detector for nSHE experiment and new type of an implantation detector utilizing the inorganic scintillator) has been started.

Related to the superheavy element physics, theoretical studies on fusion and fission processes are being carried out. Collective inertia of 240Pu was calculated along the fission path by the density functional theory [4]. Development of computer code for estimating evaporation-residue cross sections is planned.

Experimental studies of structures of heavy nuclei are also ongoing at JAEA. Decay spectroscopy of n-deficient Am isotopes was done in FY2019. Through EC decay of 234Am, excited states in 234Pu are investigated by the method of gamma-ray spectroscopy at JAEA-ISOL [5]. Isomer spectroscopy using multi-nucleon transfer reaction on actinides targets will also be performed in near future.

**References**

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